ISBN 0-7729-4198-X

A REPORT ON THE PHYTOTOXICOLOGY SECTION INVESTIGATION NEAR WELLAND CHEMICAL LTD. SCOTT ROAD, SARNIA AUGUST 17, 1987

AUGUST 1988

Environment Ontario

Jim Bradley
Minister

ISBN 0-7729-4198-X

A REPORT ON THE PHYTOTOXICOLOGY SECTION INVESTIGATION NEAR WELLAND CHEMICAL LTD., SCOTT ROAD, SARNIA, ON AUGUST 17, 1987

Report No: ARB - 023 - 88 - PHYTO

By: D.S. Harper

Date: August 1988

c Queen's Printer for Ontario, 1988

Introduction

Nous avons fait une analyse phytotoxicologique de la végétation au voisinage de la Welland Chemical Limited, chemin Scott, à Sarnia, une première fois en 1970, puis de façon continue à partir de 1978. La Welland Chemical produit du chlorure d'aluminium qui, s'il se dégage dans l'atmosphère pendant qu'il est fabriqué ou conditionné, est hydrolysé et forme de l'oxyde d'aluminium et de l'acide chlorhydrique. Les rapports d'études antérieures fournissent la preuve d'une détérioration des feuilles sensibles dans une zone s'étendant jusqu'à 250 mètres autour de l'usine. Cette détérioration a été associée à une concentration élevée de chlorure dans les feuilles touchées. Nous avons également relevé des concentrations élevées - et dans un cas, excessives - d'aluminium, elles aussi liées à la présence de l'usine. Dans les années 1983 à 1985, la détérioration des feuilles et les concentrations de chlorure et d'aluminium qu'elles contenaient étaient de beaucoup inférieures à ce qu'elles étaient dans les années précédentes. Le présent rapport résume les conclusions de l'étude de 1987 et les compare aux observations et aux résultats analytiques des cinq années précédentes.

INTRODUCTION

Phytotoxicology vegetation assessment surveys were carried out in the vicinity of Welland Chemical Ltd., Scott Road, Sarnia, first in 1970, then continuously since 1978. Welland Chemical is a producer of aluminum chloride, which, if emitted to atmosphere during manufacture or packaging, is hydrolysed to aluminum oxide and hydrogen chloride. Reports on the earlier surveys documented extensive chloride injury on sensitive plant foliage in an area up to 250 meters from the company. These injuries were associated with elevated chloride concentrations in the injured foliage. Elevated and on one occasion, excessive concentrations of aluminum were also found in a pattern related to the company. In the years 1983 through 1985 both injury and chloride and aluminum concentrations in foliage were substantially lower than in previous years. This report summarizes the results of the 1987 survey with comparisons to the previous five years' observations and analytical results.

SURVEY DESIGN

As in recent years, bur oak (Quercus macrocarpa) foliage was collected at eleven sites within 750 meters of Welland Chemical. Triplicate samples of foliage from each site were collected into clean plastic bags and delivered to the Phytotoxicology Section processing laboratory in Toronto for drying and grinding. The samples were submitted subsequently, to the Ministry of the Environment, Laboratory Services Branch's Inorganic Trace Contaminants Section for chloride, aluminum and sodium analysis.

At each collection site, in addition to sampling for chemical analysis, numerous indigenous plant species were examined for air pollution injury. These species included: bur oak (used for the chemical analysis sampling program described above), basswood, hawthorn, elm and white ash. Other species such as ragweed, goldenrod, sumac, dogwood, eastern cottonwood and shagbark hickory, which displayed less sensitivity to chloride in past years, were also examined.

OBSERVATIONS AND RESULTS

(a) Vegetation injury

Typical chloride injury has been observed on foliage of sensitive plant species near the company in all years in which this survey has been conducted. Observations on bur oak foliage made since 1982 are presented in Table 1. Until 1982 extensive chloride injury was observed on foliage in an area up to 250 meters of the company. Since 1982, significantly less injury has been observed on sensitive plant species to the extent that by 1985 only trace amounts were observed on the oak and other sensitive vegetation at Sites 1, 4 and 10 (within 100 meters of the company's perimeter fence). In 1986 and 1987 slightly more injury was observed on bur oak at sampling Sites 1 and 4 respectively, compared to 1985. Less injury was observed at sampling Site 10 in 1986 and 1987. This was considered due in part, however, to the death of chloride sensitive bur oaks in the immediate vicinity of that site. The death of these trees also necessitated a change in the oak tree sampled for chemical analysis in both years.

(b) Chloride analyses

Chloride concentrations in bur oak foliage, for the six year period 1982 to 1987, are presented in Table 2. As noted in the 1986 report, significant declines in both leaf injury and foliar chloride concentrations were observed between the 1982 and the 1983 growing seasons. Between 1983 and 1986 there was relatively little change in both parameters. In 1987, however, there was a marginal but significant overall increase in the chloride concentrations in bur oak foliage. A decline in the chloride levels at Site 1 was more than compensated for by increases at Sites 4 and 7. The net increase for these four sites is highlighted by the four-site (sampling Sites 1,4,7 and 10) means for chloride shown at the bottom of Table 2.

Although chloride concentrations continue to decline with distance from the company, concentrations at 6 sites in the vicinity of Welland Chemical in 1987 remain above that level considered the 'upper limit of normal' by the Phytotoxicology Section (0.15%, dry weight) for rural locations.

(c) Aluminum

Like chloride, aluminum concentrations in oak foliage (Table 3) declined significantly between 1982 and 1983, and like the chloride concentrations, aluminum levels remained relatively constant between 1983 and 1986. In 1987, aluminum concentrations in oak foliage, collected near the company, rose significantly, a rise created by increases at Sites 4, 7 and 10 which was only partially offset by a lower concentration at sampling Site 1. Although aluminum concentrations decline with distance from the company, all values in 1987 were well below that level considered the 'upper limit of normal' by the Phytotoxicology Section (500 ppm, dry weight).

(d) Sodium

Sodium results for the 1987 vegetation collection (Table 4) were essentially unchanged from the previous four years. Although uptake of sodium as sodium chloride from the roadside ditch continues to result in obvious sodium contamination of foliage at Site 11, the amount taken up was not high enough to influence the interpretation of the chloride results at this site, vis-a-vis Welland Chemical.

SUMMARY

Foliar chloride injury was observed in 1987 on sensitive vegetation at three locations in the immediate vicinity (within 100 meters of the Company property line) of Welland Chemical's St. Clair Works, Scott Road, Sarnia. This injury was somewhat more severe than that observed during similar Phytotoxicology Section surveys in the years 1983 through 1985, but relatively unchanged from 1986. Elevated chloride concentrations were found in oak foliage collected at these sites. Both the chloride injury and the chloride contamination of foliage declined with distance from Welland Chemical.

TABLE 1

VISUAL ASSESSMENTS OF CHLORIDE INJURY ON SENSITIVE TREE SPECIES IN THE VICINITY OF WELLAND CHEMICAL, 1982 TO 1987

SAMPLING SITE	VISUAL INJURY RATING * FOR BUR OAK FOLIAGE (by year)					
	1982 (Sept.3)	1983 (Aug.22)	1984 (Aug.21)	1985 (Aug.20)	1986 (Aug.20)	1987 (Aug.17)
1	M	L	T	T	L	T
2	NI	NI	NI	NI	NI	NI
4	T	T	NI	T	T	L
5	NI	NI	NI	NI	NI	NI
6	NI	NI	NI	NI	NI	NI
7	L	T	T	NI	T	T
8	NI	NI	NI	NI	NI	NI
9	NI	NI	NI	NI	NI	NI
10	L	T	T	T	NI	NI
11	NI	NI	NI	NI	NI	NI
12	NI	NI	NI	NI	NI	NI

* Injury Ratings: M - moderate (11 to 35% necrosis or chlorosis)
L - light (2 to 10% necrosis or chlorosis)
T - trace (<2% foliar necrosis or chlorosis)
NI - no pollutant injury

TABLE 2

RESULTS OF CHLORIDE ANALYSES OF TREE FOLIAGE COLLECTED IN THE VICINITY OF WELLAND CHEMICAL, 1982 TO 1987

SAMPLING SITE	CHLORIDE CONCENTRATION IN OAK FOLIAGE (%, dry weight) by sampling year					
	1982	1983	1984	1985	1986	1987
1	1.18	0.33	0.38	0.31	0.61	0.36
2	0.11	0.08	0.08	0.10	0.13	0.07
4	0.42	0.39	0.23	0.37	0.34	0.53
5	0.36	0.32	0.18	0.23	0.24	0.28
6	0.09	0.10	0.11	0.12	0.15	0.17
7	0.82	0.49	0.23	0.34	0.25	0.52
8	0.06	0.05	0.07	0.04	0.06	0.08
9	0.07	0.02	0.05	0.05	0.05	0.04
10	0.60	0.27	0.27	0.43	0.25	0.30
11	0.31	0.19	0.20	0.26	0.19	0.14
12	0.24	0.13	0.13	0.09	0.12	0.11
Four site (1,4,7 and 10) means	0.76	0.37	0.28	0.36	0.36	0.43
Upper limits of normal						
Rural	0.15	0.15	0.15	0.15	0.15	0.15

TABLE 3

RESULTS OF ANALYSIS FOR ALUMINUM OF TREE FOLIAGE COLLECTED IN THE VICINITY OF WELLAND CHEMICAL, 1982 TO 1987

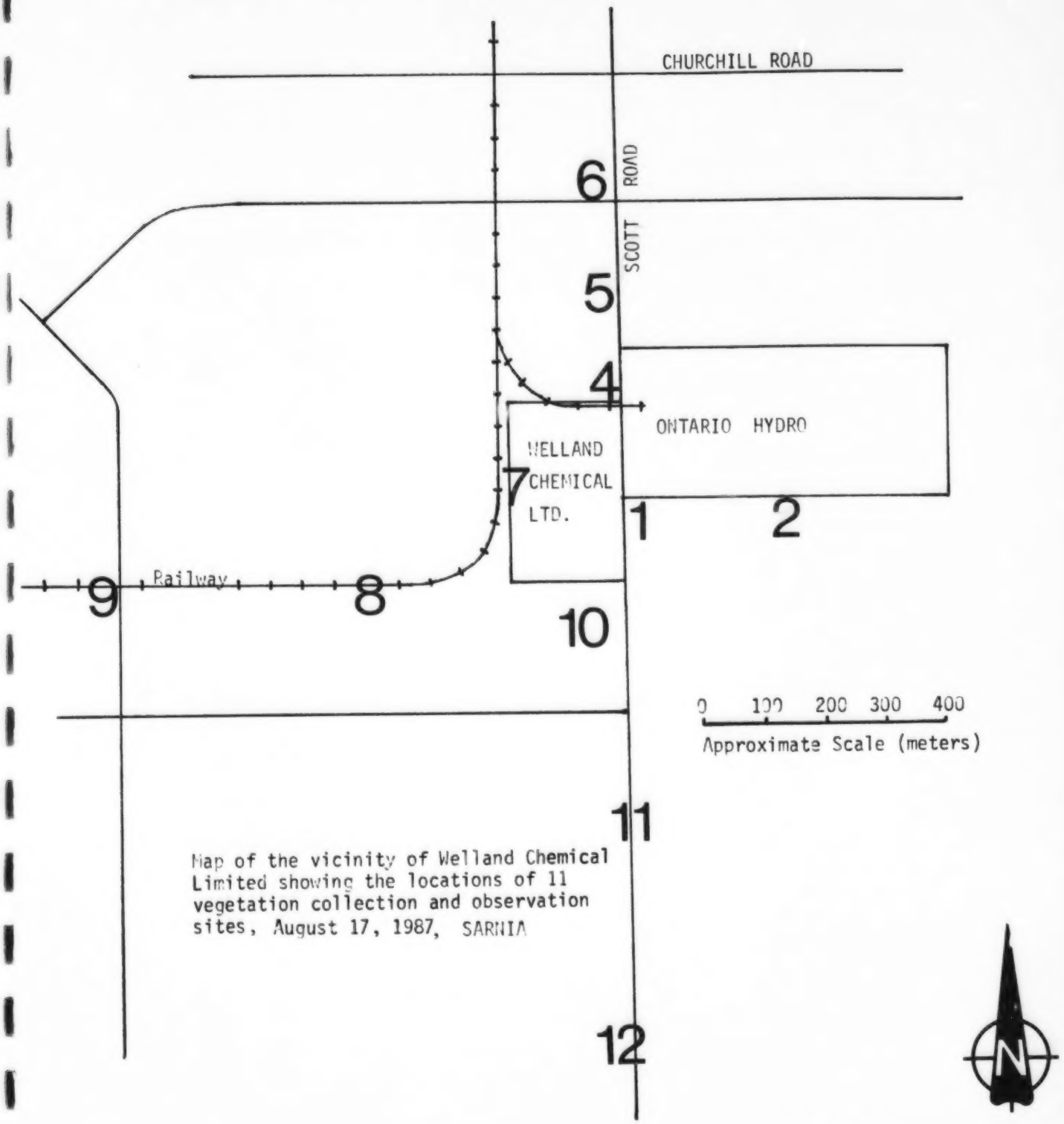
SAMPLING SITE	ALUMINUM CONCENTRATION IN OAK FOLIAGE (ppm, dry weight) by sampling year					
	1982	1983	1984	1985	1986	1987
1	543 **	170	82	110	150	99
2	86	71	75	61	58	52
4	200	117	66	87	55	135
5	107	123	47	91	38	77
6	24	57	58	49	21	53
7	228	203	73	120	35	120
8	50	39	38	42	22	39
9	36	67	33	45	23	35
10	314	137	97	110	51	100
11	170	237	275	200	137	135
12	162	91	75	79	67	71
Four site (1,4,7 and 10) means	321	157	80	107	73	114

** this value was above that level (500 ppm) considered to be the 'Upper Limit of Normal' by the Phytotoxicology Section

TABLE 4

RESULTS OF ANALYSIS FOR SODIUM OF TREE FOLIAGE SAMPLES COLLECTED IN THE VICINITY OF WELLAND CHEMICAL, 1982 TO 1987

SAMPLING SITE	SODIUM CONCENTRATION IN OAK FOLIAGE (ppm, dry weight) by sampling year					
	1982	1983	1984	1985	1986	1987
1	305	137	71	70	88	50
2	136	56	47	65	72	52
4	170	49	75	48	41	41
5	156	74	51	55	59	40
6	32	28	42	34	40	27
7	114	54	73	50	85	72
8	88	27	36	31	49	28
9	38	41	60	47	66	39
10	247	86	83	58	49	46
11	500	214	440	300	183	200
12	236	54	745	61	72	55
Upper limits of normal						
Urban	350	350	350	350	350	350
Rural	50	50	50	50	50	50



Map of the vicinity of Welland Chemical Limited showing the locations of 11 vegetation collection and observation sites, August 17, 1987, SARNIA